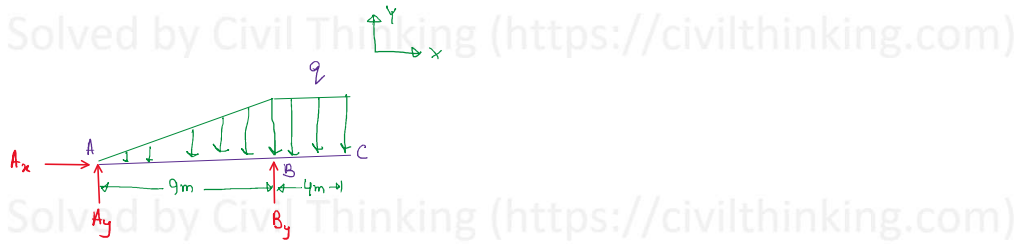
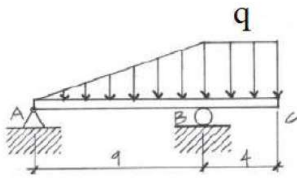


Shear and Moment Diagrams:

3. Draw the load, shear, and moment diagrams for an overhang beam with a triangular and uniform load. $q=6000\text{N/m}$



$$\boxed{\sum \overset{\curvearrowright}{M}_A = 0 :}$$

$$-(B_y \times 9\text{m}) + \left(q \times 4\text{m} \times \left(\frac{4\text{m}}{2} + 9\text{m} \right) \right) + \left(\frac{1}{2} \times q \times 9\text{m} \times \frac{2}{3} \times 9\text{m} \right) = 0$$

$$\Rightarrow 9B_y = 4q \times (2+9) + 27q \Rightarrow B_y = \frac{44q + 27q}{9}$$

$$q = 6000\text{N/m} \text{ [provided in the problem]}$$

$$\Rightarrow B_y = 47333.33\text{ N}$$

$$\boxed{+\uparrow \sum F_y = 0 :}$$

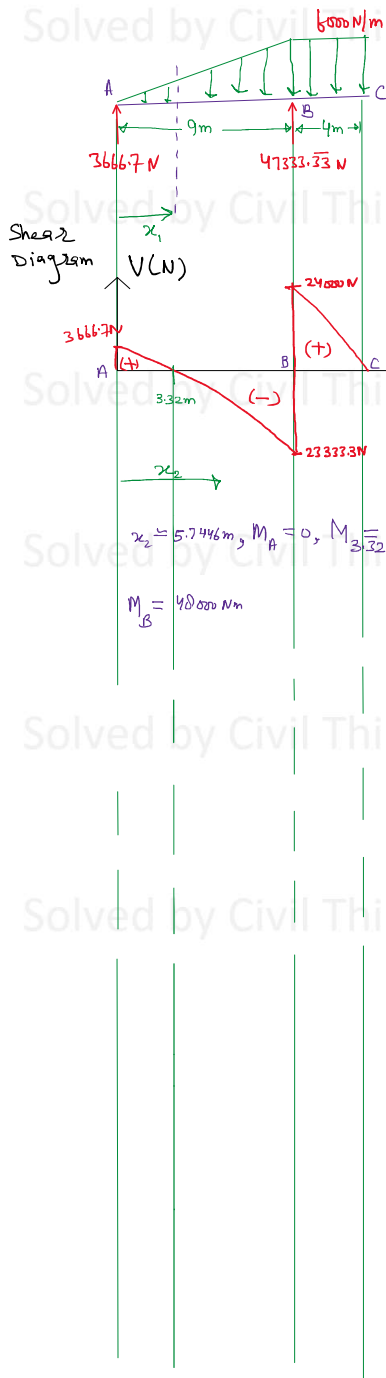
$$A_y + B_y - 4q - \frac{1}{2} \times q \times 9 = 0$$

$$B_y = 47333.33\text{ N}, q = 6000\text{N/m}$$

$$\Rightarrow A_y = 3666.7\text{ N}$$

$$\boxed{+\rightarrow \sum F_x = 0 :}$$

$$A_x = 0$$

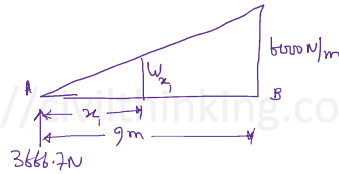


Finding Shear forces at different locations:

$$\rightarrow V_A = 3666.7 \text{ N}$$

$$\rightarrow V_B^- = 3666.7 - \left(\frac{1}{2} \times 9 \text{ m} \times 6000 \text{ N/m}\right) = -24000 \text{ N}$$

Zero shear force location between A and B:



$$\frac{w_x}{x} = \frac{6000 \text{ N/m}}{9 \text{ m}} = \frac{2000 \text{ N/m}}{3 \text{ m}}$$

$$\Rightarrow w_x = \frac{2000 \text{ N/m}}{3 \text{ m}} x$$

$$(\uparrow) V_{x_1} = 0 :$$

$$3666.7 \text{ N} - \frac{1}{2} (x_1 \times w_{x_1}) = 0$$

$$\Rightarrow 2 \times 3666.7 \text{ N} = x_1 w_{x_1}$$

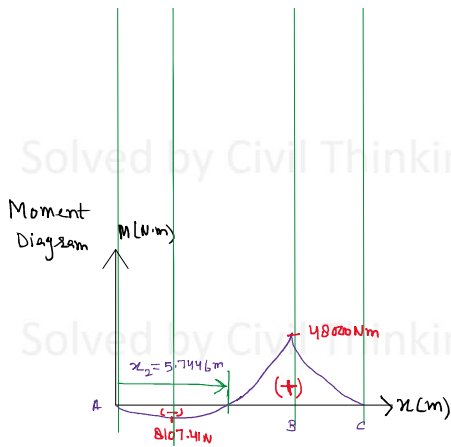
$$\Rightarrow x_1 = \frac{2 \times 3666.7 \text{ N}}{w_{x_1}} = \frac{2 \times 3666.7 \text{ N}}{\frac{2000 \text{ N/m}}{3 \text{ m}} x_1} = 3.32 \text{ m}$$

\Rightarrow At $x_1 = 3.32 \text{ m}$, shear force is zero.

$$\rightarrow V_{B^+} = V_{B^-} + 47333.33 \text{ N} = -24000 \text{ N} + 47333.33 \text{ N} = 24000 \text{ N}$$

$$\rightarrow V_C = 0$$

Finding Moments at different points (\Rightarrow):



Finding Moments at different points (→):

$$\rightarrow M_A = 0;$$

$$\rightarrow M_{3.32\text{m}} = -(3666.7 \text{ N} \times 3.32 \text{ m}) + \left(\frac{1}{2} \times 3.32 \text{ m} \times w_{3.32} \times \frac{3.32 \text{ m}}{3} \right)$$

$$\Rightarrow \frac{6000 \text{ N/m}}{9 \text{ m}} = \frac{w_{3.32}}{3.32 \text{ m}}$$

$$\Rightarrow w_{3.32} = \frac{6000}{9} \times 3.32 \text{ m} = 2213.33 \text{ N}$$

$$\Rightarrow M_{3.32\text{m}} = -(3666.7 \text{ N} \times 3.32 \text{ m}) + \left(\frac{1}{2} \times 3.32 \text{ m} \times 2213.33 \times \frac{3.32 \text{ m}}{3} \right) = -8107.41 \text{ N}$$

$$\rightarrow M_B = -(3666.7 \text{ N} \times 9 \text{ m}) + \left(\frac{1}{2} \times 6000 \text{ N/m} \times 9 \text{ m} \times \frac{9 \text{ m}}{3} \right) = 48000 \text{ Nm}$$

Since $M_{3.32\text{m}}$ is Negative and M_B is Positive, there must be some point between them where moment is zero. Let's find its location:

Zero Moment location Between $x = 3.32 \text{ m}$ and point B ($x = 9 \text{ m}$)

$$M_{x_2} = 0$$

$$\Rightarrow w_{x_2} = \frac{6000}{9} \times x_2$$

$$M_{x_2} = 0:$$

$$\Rightarrow -3666.7 \text{ N} \times x_2 + \left(\frac{1}{2} \times x_2 \times w_{x_2} \times \frac{x_2}{3} \right) = 0$$

$$\text{Put } w_{x_2} = \frac{6000}{9} x_2$$

$$\Rightarrow -3666.7 \text{ N} \times x_2 + \left(\frac{1}{2} \times x_2 \times \frac{6000}{9} x_2 \times \frac{x_2}{3} \right) = 0$$

$$\Rightarrow x_2 = 5.7446 \text{ m}$$

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